

## DESCRIPTION

## WIRELESS TRANSMISSION CONTROL IN UWB (ULTRA WIDE BAND) TECHNOLOGY

5 The invention relates to a method and apparatus for controlling transmission activity of wireless devices, particularly but not exclusively Ultra Wide Band devices.

10 Ultra Wide Band (UWB) technology is set to become in the next few years one of the most important means to transmit information wirelessly at a high data rate. After the Federal Communications Commission (FCC) First Report and Order of 14th February 2002 for the US region, a new market is open for mobile data devices, and legislation is expected to follow soon also in Europe. Some of the advantages of UWB technology are unlicensed reuse of 15 existing radio spectrum, simpler transceiver architecture, higher data transmission rates and an accurate ranging capability.

One of the major concerns still putting in doubt the success of UWB is its capability to coexist with other services without effecting too much their operation. UWB transmissions are in frequency bands already occupied by 20 other commercial systems, such as cellular systems, microwave links and satellite links, with the main frequencies of transmissions forecast to be between 3.1 GHz and 10.6 GHz, but with emissions also in other regions of the spectrum according to the power masks shown in Figure 2. In Figure 2 the mask drawn with a solid line illustrates the FCC UWB transmission limits for 25 indoor communications devices, as officially approved in February 2002 and allowing commercial deployment of UWB devices, in terms of maximum admissible average EIRP (Effective Isotropic Radiated Power) over a large set of frequencies. In Figure 2 the dashed lines illustrate corresponding UWB transmission limits under discussion in the European Telecommunication 30 Standards Institute (ETSI), and the dot-dash line constant at -41.3 dBm/MHz is the FCC Part 15 Limit on unintentional radiation from electronic equipment

such as personal computers, kitchen appliances, shavers, televisions and other broadcast receivers.

Furthermore, steps are required to minimise the power consumption of UWB chipsets to make them more competitive with other low power wireless solutions, such as Bluetooth™. First generation UWB chipsets may consume in the region of 200mW, which is four to five times more than current Bluetooth™ chipsets.

An object of the invention is to enable a reduction of interference.

According to a first aspect of the invention there is provided a method of controlling wireless transmission by one or more wireless devices, comprising a measuring transmission activity level of one or more wireless devices and, in response to the measured transmission activity level complying with a predetermined criterion, controlling the transmission activity of at least one of the wireless devices.

According to a second aspect of the invention there is provided an apparatus for controlling wireless transmission by one or more wireless devices, comprising measurement means for measuring a transmission activity level of one or more wireless devices and control means responsive to the measured transmission activity level complying with a predetermined criterion for controlling the transmission activity of at least one of the wireless devices.

According to a third aspect of the invention there is provided a system comprising an apparatus according to the second aspect of the invention and one or more wireless devices comprising a transmitter means responsive to signalling generated by the control means for varying the transmission activity.

Ways of measuring the transmission activity level include measuring the proportion of transmission time over a predetermined time period for one or more wireless devices, or measuring an indication of aggregate power transmitted by a plurality of wireless devices averaged over a predetermined time period.

Ways of controlling the transmission activity include reducing the transmit power level of one or more of the devices, a special case of which

comprises prohibiting transmission by one or more of the devices for a further predetermined time period.

By controlling the activity factor the level of interference generated by wireless devices can be reduced, and also the power consumption of the 5 wireless devices can be reduced.

The apparatus for controlling wireless transmission may be integral with a wireless device that it controls. The apparatus may control one or more external devices by wireless communication.

The invention is based on the realisation that wireless devices in active 10 use commonly transmit for only a fraction of the maximum theoretical time, and that performing temporal averaging and control is a practical way of controlling interference levels and also enables power consumption to be reduced. In this specification, the apparatus for controlling the transmission activity is also referred to as an activity factor controller.

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The invention will now be described, by way of example only, with reference to the accompanying drawings wherein:

Figure 1 is a block schematic diagram of a cluster of wireless devices;

Figure 2 is a graph showing regulatory emission limits;

20 Figure 3 is a graph showing simulation results for the aggregate interference effect from UWB to a Fixed Wireless Access (FWA) hot-spot link with different activity factors.

Referring to Figure 1, there is illustrated a cluster of UWB wireless 25 devices 10 and an activity factor controller 20. Each wireless device 10 comprises a UWB transmitter 12. The activity factor controller 20 comprises a measurement means (M) 22 for measuring the transmission activity level of the wireless devices 10 and a control means (C) 24 for controlling transmission activity of the wireless devices 10 by signalling over a link 30. The link 30 is 30 illustrated for one wireless device only, but in practice may exist for each wireless device 10 to be controlled. The link 30 may be wired or wireless. Optionally the activity factor controller 20 comprises a location means (L) 26,

for example a GPS receiver, for determining the location of the activity factor controller 20.

The measurement means 22 measures the quantity of transmission activity by the wireless device 10 over a time period and when the level of 5 transmission activity complies with a predetermined criterion, the control means 24 exerts control over further transmissions.

In measuring the quantity of transmission activity, examples of parameters that may be taken into account are: total transmission time; aggregated transmit power; duration of transmission time periods; the duration 10 of the intervals between transmission time periods; and the time of maintenance of a given quality of service, for example a given bit rate. The predetermined criterion may comprise one or more of the above parameters.

Examples of the predetermined criterion are: total transmission time over the measurement time period reaches a predetermined duration; total 15 transmission time above a predetermined power level over the measurement time period reaches a predetermined duration; the number of transmissions exceeding a predetermined duration reaches a predetermined value; and the total time of transmissions at a given data rate, for example over 200 Mbit/s that may result in increased interference, exceeds a predetermined value.

Examples of the control that may be exerted over further transmissions 20 are: transmission may be prohibited for a predetermined time period; transmit power may be reduced, possibly to zero, for a predetermined time period; the maximum transmission duration may be reduced; a minimum time period between transmissions may be extended; and the data rate may be reduced in 25 order to reduce the potential of interference with other services. A combination of such transmission attributes may be controlled.

The activity factor controller 20 can be implemented in either of two different ways:

a) The activity factor controller 20 may measure and control a single 30 wireless device 10, in which case it may be integral with the wireless device 10, so that the controlling and controlled functions exist within the same physical device.

b) The activity factor controller 20 may measure and control a plurality of wireless devices 10. In this case the measured transmission activity level may be the average over the plurality of wireless devices 10. Such a scheme may be deployed, for example, in a home, office or factory environment. The 5 activity factor controller 20 may base its control decisions on priorities assigned by a user dependent on his/her daily needs and dependent on the class of service provided by each wireless devices 10, for example by switching off or reducing the quality of service of lower-priority wireless devices first.

10 A consequence of the control exerted by the activity factor controller 20 is a reduction in the amount of interference generated by the controlled wireless devices 10, and a reduction in power consumption in those devices. A further consequence of the control exerted by the activity factor controller 20 is likely to be a reduction in the quality of service provided by the wireless 15 devices 10. In data transfer applications this might mean a longer wait for file transfers. In sensing applications, this might mean a lower refresh rate of the system. In video transmission systems, this might mean, for example, switching to a lower resolution mode.

The predetermined criterion for judging the transmission activity level, or 20 the control exerted by the activity factor controller 20, may be dependent on the location of the activity factor controller 20 or of the wireless devices 10. For example, the aggregate interference power generated by the wireless devices 10 might be of concern for a large building which sits in close proximity to a FWA microwave link, but may have no noticeable influence on small 25 homes or countryside places where only a small number of wireless devices 10 are used. A user may select the criterion or type of control, or the selection may be made automatically in response to an indication of location provided by the location means 22 or any other source.

The predetermined criterion for judging the transmission activity level, or 30 the type of control exerted by the activity factor controller 20, may be automatically updated by data received from a central database UWB radio congestion controller station, which monitors in real time the effects of

interference caused by the wireless devices 10 in key areas that need suitable protection, such as vital microwave relay links in disaster areas so that communications can be maintained active by disabling wireless devices 10 having low priorities.

5 The activity factor controller 20 may include a means of displaying information to a user. For example, the user may be warned when the transmission activity of a wireless device 10 reaches an intermediate level less than the level at which control starts to be exerted by the control means 24. This warning enables the user to moderate usage of the wireless device 10,  
10 and perhaps delay or prevent the onset of control of the transmission activity by the activity factor controller.

15 The activity factor controller 20 may control transmissions by scheduling the transmission time of one or more of the devices (10) in given time slots according to a dynamic timetable which is created and periodically updated based on preset congestion limits for the area under control by the activity controller 20.

20 Optionally the control means 24 of the activity factor controller 20 may comprise a memory means 28 for storing a timetable and may schedule the transmissions of one or more of the wireless devices 10 in accordance with the stored timetable. The timetable may be based on preset congestion limits, which may be location dependent. The timetable may be dependent on the location of the wireless device 10 to be controlled, and may be updated in response to location information received from a wireless device 10. The timetable may be updated in response to received congestion bulletins; for  
25 example, the control means 24 may receive centrally emitted orders to block the traffic in a particular area following external, even independent, reports of cases of severe radio wave congestion or potentially harmful interference, for example following a reported malfunctioning of a system which might sit close to a UWB hot-spot.

30 A network of activity factor controllers 20 may be put in place with each one controlling and updating the schedule for a particular geographical area

based on location-information received from one or more of the devices (10) and/or using received congestion bulletins.

Figure 3 illustrates simulation results for the reduction in interference power, measured in dBW/MHz as a function of distance, obtainable by 5 reducing the activity level in accordance with the invention. Figure 3 illustrates the aggregate interference power produced by UWB devices as seen by a Fixed Wireless Access (FWA) microwave receiver positioned at a variable distance from the UWB transmitters. Referring to Figure 3, three curves are plotted, for activity factors of 1% (lower curve), 5% (middle curve) and 10% 10 (upper curve) for a set of wireless devices 10 positioned in the receive path of a FWA link and operating with a typical duty cycle. As an example, these curves show that, at a distance of 1km, by limiting the transmissions activity level of the wireless devices 10 to 1%, i.e. the percentage time of transmission aggregated over all wireless devices, the aggregated interference power is 15 reduced by about 13dB compared with what it would be if the activity level were allowed to reached 10%. The level of interference decreases as the distance increases, due to path loss.

In the present specification and claims the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. 20 Further, the word "comprising" does not exclude the presence of other elements or steps than those listed.

The inclusion of reference signs in parentheses in the claims is intended to aid understanding and is not intended to be limiting.

From reading the present disclosure, other modifications will be 25 apparent to persons skilled in the art. Such modifications may involve other features which are already known in the art of UWB and the art of wireless devices and which may be used instead of or in addition to features already described herein.